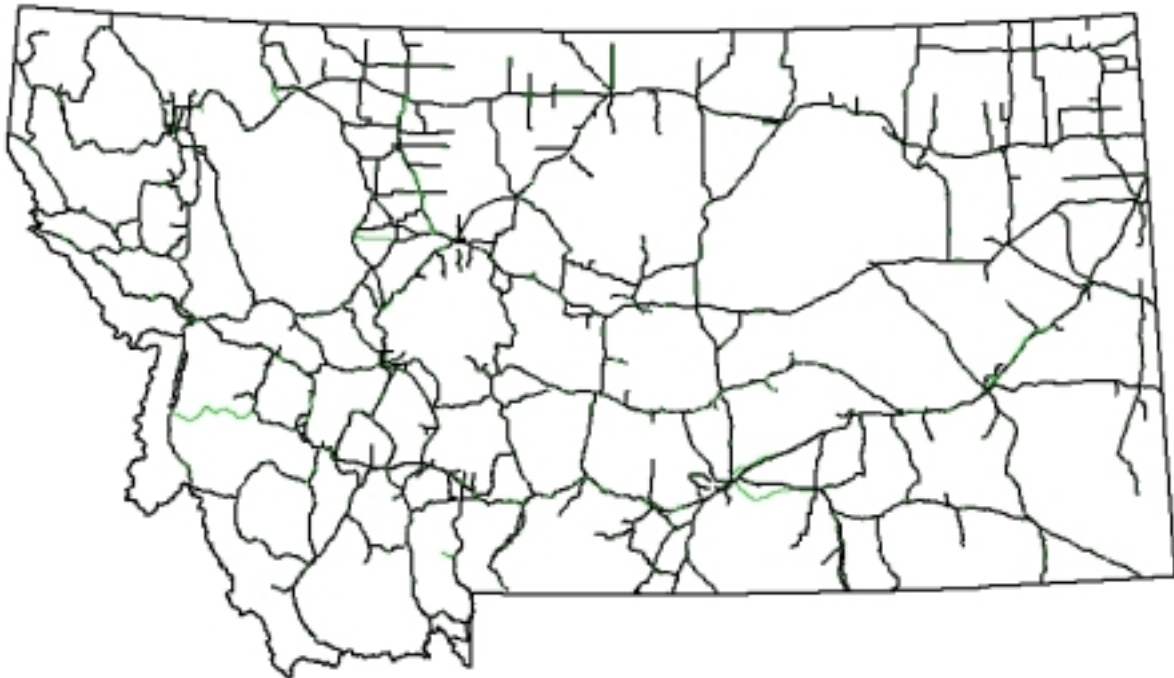

Montana Department of Transportation

STATEWIDE

Integrated Weed Management Plan

2003-2008

Montana Department of Transportation Maintenance Division &
Montana Department of Agriculture
Helena, Montana



April 21, 2003

Montana Department of Transportation

STATEWIDE Integrated Weed Management Plan

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Chapter 1. Purpose & Need for Action

INTRODUCTION

Highway rights-of-way are high-risk sites for introduction, establishment, and spread of noxious weeds. Weeds can be carried on vehicles, in the loads they carry, and on construction and maintenance equipment. They can be inadvertently introduced into rights-of-way during restoration projects by use of contaminated mulch, soil or gravel, plant seed, and sod. Historically, some invasive plant species have been deliberately planted in erosion control, landscape, or wildflower projects. Weeds established on roadsides can spread into adjacent non-infested areas and can also be transported to surrounding counties and states. It is critical to develop a comprehensive integrated management strategy to address noxious weed issues on approximately 156,000 acres of highway rights-of-way owned by Montana Department of Transportation (MDT).

For purposes of this document, a weed is defined as any plant that interferes with management objectives for a given area of land (or body of water) at a given point in time. Once a plant has been classified as a weed, it attains a "noxious" status by rule as described in the County Noxious Weed Control Act. The Montana County Noxious Weed Management Act defines a "noxious weed" as any exotic plant species established or that may be introduced into the state which may render land unsuitable for agriculture, forestry, livestock, wildlife, or other beneficial uses and is further designated as either a state-wide or county-wide noxious weed.

Montana Department of Transportation in cooperation with County Weed Districts and Montana Department of Agriculture developed criteria for managing weeds on roadsides. MDT recognizes that objectives, expected results, and needs of each county may vary. Overall purpose and objectives will remain consistent throughout Montana.

PURPOSE

The purpose of MDT's Statewide Roadside Integrated Weed Management Plan is to guide ecologically-based integrated weed management strategies on roadsides that strengthen and support national, state, city and county roadside vegetation management objectives. This Management Plan provides a conceptual framework and recommendations for actions to reduce existing

infestations, maintain low noxious weed soil-seed bank levels, reduce susceptibility of road rights-of-way to weed establishment, and manage spread of noxious weeds along state roads in Montana. This document was developed to provide guidance and direction while maintaining flexibility for local priorities and actions on a countywide level.

Objectives of the roadside integrated weed management plan provide overall direction to MDT and include:

1. Promote healthy, low maintenance, and self-sustaining roadside vegetation while maintaining right-of-way safety and function.
2. Prioritize roadside noxious weed management strategies by species, abundance, and location statewide.
3. Develop and implement action items that support integrated noxious weed management components on roadsides statewide.
4. Develop a statewide inventory and database for noxious weeds on roadsides.
5. Develop stable long-term funding to support implementation of IWM on state road rights-of-way.

This Plan is a dynamic document that integrates: 1) needs of local communities and highway users; 2) knowledge of plant ecology and natural processes; 3) design, construction and maintenance considerations; 4) government statutes and regulations; and 5) technology. Individual county plans will be evaluated and revised annually. Specific objectives, issues, and programs are discussed to improve weed management efforts on roadsides, foster coordination between county and state entities, and increase public awareness about noxious weed issues. Expected results of the weed management program are identified.

NEED FOR ACTION

Rate of introduction and spread of noxious weeds has increased dramatically over the past 150 years as human activities, trade, and commerce have increased. Transportation corridors serve as a

critical avenue for introduction, establishment, and spread of weeds throughout Montana (Chicoine 1984; Forcella and Harvey 1983; Losensky 1989). A study conducted on spotted knapweed by Montana State University indicated that a vehicle driven several feet through a knapweed site acquires up to 2000 seeds (Trunkle and Fay 1991). These seeds are dispersed along highways, with about 200 seeds remaining on a vehicle after driving 10 miles. The Montana legislature identified vehicles and associated transportation routes as major vectors of noxious weed introduction and spread to adjoining lands. In 1987 and 1989, they approved an annual \$1.50 per vehicle fee on all motor vehicles registered in Montana to be used to fund weed management projects through the Noxious Weed Trust Fund Program.

Once established on roadsides, noxious weeds spread rapidly to adjoining cropland and wildland areas infesting thousands of acres (Losensky 1989, Tyser and Key 1988; Duncan et al 2001). Currently there are 23 weeds on Montana's noxious weed list that infest about eight million acres in the state (Duncan 2001).

The impact of weeds on biological communities, ecosystem processes, and the agricultural economy is well documented in Montana. Studies have shown that replacement of native bunchgrasses with taproot weeds such as spotted knapweed can increase surface water runoff and soil erosion by 56% and 192% respectively (Lacey et al, 1989). This influences water quality in streams and rivers, and ultimately impacts productive potential of the land. Weeds have been shown to influence wildlife by reducing forage, modifying habitat structure - such as changing grassland to a forb-dominated community, or changing species interactions within the ecosystem (Belcher and Wilson, 1989; Bedunah, 1989; Trammell and Butler, 1995; Thompson, 1996). Non-native plants also threaten biological diversity of native plant communities by displacing native species (Tyser & Key, 1988) and can threaten the survival of rare and sensitive plants (Lesica, 1991).

The cost of spotted knapweed and leafy spurge to Montana's economy is substantial. Bioeconomic models were used to evaluate annual economic impact of these weeds on grazing land and wildland values. Total impact from spotted knapweed infestations were estimated at \$42 million per year, which could support 518 full time jobs in the state (Hirsch and Leitch, 1996). If all vulnerable lands in

the state were infested with spotted knapweed (34 million acres), the annual cost to Montana's livestock industry alone would be \$155 million (Bucher, 1984). The impact of leafy spurge to Montana's economy was estimated at \$18.6 million per year (Leitch et.al., 1994).

The key to management of noxious weeds is early detection and control of infestations to prevent spread into non-infested areas. Road rights-of-way are high-risk areas for introduction of new weeds to the state and are a major site of spread of established noxious weeds. Therefore, management of noxious weeds along roadsides is critical to meeting county, state, and national weed management objectives.

PROPOSED ACTION

Montana Department of Transportation proposes an ecological approach to weed management using integrated methods consistent with the Montana Weed Management Plan (2001) and National Invasive Species Management Plan (2001). This includes analyzing site conditions and prescribing management components to meet objectives and expected results.. This plan included development of detailed roadside weed management plans in Missoula, Lewis and Clark, and Phillips Counties. These counties represent high, moderate, and low weed infestation levels respectively, and helped provide roadside weed management criteria to the statewide plan: Weed treatments are discussed in this document, and support and strengthen national, regional, and state directives as they apply to MDT lands.

Management of noxious weeds on state owned rights-of-way requires a comprehensive plan of action with six major components. These components are: 1) public awareness and education; 2) prevention and early detection; 3) rapid response and management; 4) restoration and rehabilitation; 5) research and new technology; and 6) inventory, monitoring, and evaluation. Management techniques utilized may include manual, mechanical, chemical, cultural, and biological methodologies.

Expected results from each component of the management plan are described below. Action items addressing each of these components are described in Chapter 5.

- **Public Awareness & Education:** Increase public awareness of noxious weeds on roadsides and improve training for MDT and county employees on

identification and management of state and county designated noxious weeds.

- **Prevention & Early Detection:** Reduce establishment and stop seed production and spread of newly invading weeds on roadsides, stockpiles, and other MDT lands.
- **Rapid Response & Management:** Implement cost-effective integrated programs to stop seed production and expansion of noxious weed infestations on roadsides.
- **Restoration & Rehabilitation:** Decrease susceptibility of roadside rights-of-way to noxious weed invasion and establishment.
- **Research & New Technology:** Identify, prioritize and facilitate coordination and implementation of research and new technology that will promote reduction of noxious weeds on road rights-of-way
- **Inventory:** Accurately inventory and record locations of noxious weeds on roadsides and other MDT lands.
- **Monitoring:** Measure effectiveness of various programs over time (management, public education, etc.) and compile data to develop effective management decisions.
- **Evaluation:** Analyze integrated weed management program effectiveness.

Chapter 2. Overview of Invasive Plant Issues & Legislation

ISSUES & LEGISLATION

Noxious weed management on state-owned roadsides in Montana must comply with existing laws and legislation. This section provides an overview of national, state, and county laws, legislation and directives that will be incorporated into Integrated Roadside Weed Management Plans.

Federal Direction: Executive Order & National Invasive Species Management Plan

The President issued Invasive Species Executive Order 13112 on February 1999 that called on Executive Branch agencies to prevent and control introduction and spread of invasive species. The Order established the National Invasive Species Council, which is chaired by Secretaries of Agriculture, Commerce, and Interior and includes Departments of State, Treasury, Defense, Health and Human Services, Transportation, Environmental Protection Agency, and the U.S. Agency for International Development. The Order builds on the National Environmental Policy Act (NEPA) of 1969, the Federal Noxious Weed Act of 1974, and the Endangered Species Act of 1973 to prevent introduction of invasive species, provide for their control, and take measures to minimize economic, ecological, and human health impacts.

The National Invasive Species Council completed a National Invasive Species Management Plan in 2001. This Plan provides a blueprint for Federal action (in coordination with State, local, and private programs and international cooperation) to prevent the introduction of invasive species, provide for their control, and minimize their economic, environmental, and human health impacts. The Plan assigned the Federal Highway Administration's (FHWA) oversight in federally funded highway projects that include Interstate and State highways.

FHWA's Vegetation Management Program guides State departments of transportation on invasive species issues. Guidance on E.O. 13112 was issued to the States in September 1999, encouraging inventory and integrated management of roadside weeds before-and-after projects, assessment of invasive species during the NEPA process, and use of "Environmentally and Economically Beneficial

Landscaping" practices¹. The FHWA continues to provide technical support to all States on this vegetation issue.

Under the Executive Order, State Departments of Transportation (DOTS) have new opportunities to address roadside vegetation management issues on both their construction activities and maintenance programs. Through new levels of cooperation and communication with other agencies and conservation organizations at all levels, the highway programs offer a coordinated response against the introduction and spread of invasive species.

The Department of Transportation's policy is to fully participate in the Administration efforts to prevent introduction and spread of invasive species by 1) pursuing appropriate authorities and funding for implementation; 2) participating on interagency committees; 3) analyzing invasive species' effects in accordance with Section 2 of the Executive Order 13112; 4) increasing coordinated research; 5) implementing, at DOT facilities and DOT-funded facilities, the Presidential memorandum on beneficial landscaping; 6) coordinating with international organizations, such as the International Maritime Organization, the International Civil Aviation Organization, and the International Organization for Standardizations on cooperative efforts; 7) training agency personnel and informing the public; 8) coordinating with other federal agencies and with state, local and tribal governments; and 9) encouraging innovative designs for transportation equipment and systems.

The Department of Transportation's efforts to prevent introduction and spread of invasive species are consistent with: (1) strategic goals of protecting the natural environment, service, and teamwork; (2) statutory mandates to protect against aquatic

¹ Environmentally and Economically Beneficial Landscaping Guidelines include compliance with NEPA; use of Regionally Native Plants for landscaping; design, use, or promote construction practices that minimize adverse impacts on the natural habitat; seek to prevent pollution; implement water and energy efficient landscape practices; and create outdoor demonstration projects.

invasive species; (3) active participation on interagency committees such as the Federal Interagency Committee for Management of Noxious and Exotic Weeds (FICMNEW), the Native Plant Conservation Initiative (NPCI), the Interagency Ecosystem Management Task force, and the Interagency Working Group on Endangered Species; and (4) the 1994 Presidential Memorandum on Environmentally and Economically Beneficial Landscaping Practices.

State Direction – Montana Weed Laws & Management Plan

The first noxious weed legislation in Montana was passed in 1895. Since that time additional laws and rules have been enacted to strengthen weed management efforts. There are eight laws currently affecting weed management in Montana.

1. County Noxious Weed Control Act provides for weed management activities at the county level.
2. Montana Weed Control Act provides for technical assistance and embargoes.
3. Montana Noxious Weed Trust Fund Act is a grant funding program designed to encourage local cooperative weed management programs, creative research in weed control, including the development of biological control methods, and educational programs.
4. Montana Noxious Weed Seed Free Forage program establishes a state noxious weed seed free forage certification program which supports and complements the regional Noxious Weed Free Forage Certification Program.
5. Montana Agricultural Seed Act lists prohibited and restricted weed seed levels that must be maintained in state certified seed.
6. Montana Commercial Feed Act prohibits noxious weeds in commercial feed.
7. Montana Environmental Policy Act must be addressed by state actions

that have potential environmental or socioeconomic impacts.

8. Montana Nursery Law allows for inspection, certification, and embargo of all nursery stock for listed pests, including weeds.

The Montana Weed Management Plan was completed in 2001 to provide the conceptual framework and recommendations for actions to prevent introduction and manage the spread of invasive plants in Montana. The Plan was designed to incorporate existing Montana noxious weed laws and legislation, and to complement regional, national, and international strategies in the National Invasive Species Management Plan.

The Montana Weed Management Plan identifies the following needs for current roadside weed management programs:

1. Improve monitoring and evaluation of weed management efforts.
2. Revise reimbursement programs to county weed districts to increase efficiency and improve administration.
3. Special line item under the MDT maintenance budget exists strictly for noxious weed control on these sites.
4. Amend current MDT contracts for roadside reclamation projects to mandate that contractors contact county weed districts for reclamation requirements on roadside projects.
5. Increase funding for weed control on highway rights-of-way to meet expansion of rights-of-way in the state. The current acreage increase of rights-of-way is about 500 acres per year.
6. MDT's noxious weed coordinator will ensure compliance with County Weed Control Act, oversee coordination with counties, develop BMP's for weed management along highway rights-of-way, and improve communication with weed districts.

In addition, MDT, Montana Weed Control Association, and Weed district coordinators are to encourage coordination between road construction contractors and County Weed Districts, and to develop statewide guidelines for construction contractors to follow which would address specific

weed district concerns. The same group is also responsible for including weed control as a cost/bid item in MDT road construction projects, and to develop a system to establish funding needs and means to transfer project monies to County weed districts or commercial applicators for dedicated weed monitoring and control for a three-year period following construction.

County Direction—County Weed Management Plans

County Weed Districts implement and enforce the County Noxious Weed Control Act, in addition to conducting weed education and awareness programs, developing cooperative agreements, coordinating weed management activities within and among counties, and monitoring weed infestations on private and public lands. County Weed Management Plans should provide guidelines for compliance with the Montana County Noxious Weed Management Act, Title 7, Chapter 22, Sections 7-22-2101 through 7-22-2153, Montana Codes Annotated, and provides a framework for effective noxious weed management.

In compliance with 7-22-2151, MCA the Montana Department of Transportation is required by state statute to develop a noxious weed management plan and to have the plan approved by County Weed Boards as well as providing a biennial report on weed management activities.

The weed district may provide assistance to MDT in:

1. Developing integrated noxious weed management plans
2. Maintaining written agreements specifying the mutual responsibilities of the weed district and MDT for implementing an integrated noxious weed management plan.
3. Coordinating noxious weed management programs with private Cooperative Weed Management Groups and other local, state, and federal agencies.
4. Developing educational programs about noxious weeds for the agency's personnel and the general public.
5. Obtaining biological weed control agents and monitoring their establishment.

Section 7-22-2152, of the Montana County Noxious Weed Management Act requires any person or agency disturbing vegetation by construction in the weed district to submit a revegetation plan to the Weed Board for board approval. The plan must provide for the establishment of beneficial vegetation in the disturbed area after construction is completed.

Construction Sites & Reclamation of disturbed rights-of-way

1. MDT will allow county weed district the opportunity to review and comment on the reclamation specifications for all road construction projects that disturb ground off the driving surface.
2. Work with Federal Highway Administration to expand weed control funds from the year of construction to a minimum of 3 years following federally funded construction projects. This will reduce cost liability incurred by MDT for these projects and allow funding to be utilized in existing areas and state funded projects.
3. Some counties now require approval of borrow sources prior to any material placement within rights-of-ways, as well as power-washing of all equipment brought into construction project areas.
4. Standard Specifications for Road and Bridge Construction—1995 Edition provided strong direction to construction contractors to abide by the County Weed Management Act. Standard Specification 107.11.5-Noxious Weed Management instructs all bidders to “Determine the specific noxious weed control requirements not specified in the [Construction] Contract of each county where the project is located before submitting a bid.”

Landowner Agreements

Weed districts in the state may have developed an Herbicide Free Area Agreement for landowners who request that herbicides not be applied to roadside rights-of-way adjoining their property (7-22-2153 MCA). Property owners will contact the respective County Weed District to obtain an agreement approved by MDT. Persons signing this agreement must control noxious weeds on state-owned roadsides to meet management objectives

(containment, total control, or eradication, etc).
MDT may rescind the agreement for non-compliance with weed management criteria.

WEED LISTS & CATEGORIES

The Montana State Noxious Weed list is updated as needed and is determined by Rule of the Montana Department of Agriculture (MDA) under provisions of the County Noxious Weed Control Act. The 23 weeds on Montana's noxious weed list, in addition to a "watch" list are found in Appendix A. These 23 Montana noxious weeds are divided into three categories based on the number of acres in the state and management criteria.

In addition, weed districts may include additional noxious weeds specific to their counties (Appendix B). MDT will recognize management of both county and state listed noxious weeds for management on roadsides. In most cases, state-listed noxious weeds will have priority over county-designated species. Management criteria for species will vary based on county objectives and levels of infestations in the county.

Category 1 includes 13 noxious weeds infesting about 8 million acres and are generally widespread in many counties of the state. These weeds, such as spotted knapweed and leafy spurge, are capable of

rapid spread and render land unfit or greatly limit beneficial uses.

Category 2 includes 7 noxious weeds infesting about 86,000 acres statewide. These weeds have recently been introduced into the state or are rapidly spreading from their current infestation sites. These weeds, such as dyers woad and tansy ragwort, are capable of rapid spread and invasion of lands. Category 2 weeds would have a high priority for management on roadsides.

Category 3 noxious weeds include yellow starthistle, common crupina, and rush skeletonweed, which have either not been detected in the state or may be found only in small, scattered, localized infestations. There are 38 acres of these weeds reported in the state. Management criteria include awareness and education, early detection and immediate action to eradicate infestations.

Watch List includes scentless chamomile and white bryony which have been detected on 192 acres in the state. Management criteria include awareness, early detection, monitoring, and total control of existing infestations on roadsides.

Chapter 3. Existing Situation & Current Program

EXISTING SITUATION

Affected Area

Montana Department of Transportation maintains about 10,773 miles of centerline road through five (5) District and six (6) Area Offices. This includes 1191 miles of Interstate, 5479 miles of National and Primary Highway, and 4103 miles of Secondary Highway (including Urban and Xroutes). The area encompassed by rights-of-way is estimated at about 156,683 acres (*Appendix C*). Road construction activities, such as widening and straightening existing highways, add about 300 to 500 acres of new right-of-way per year. *Figure 1* shows the location of MDT District Offices in Montana

The U.S. DOT's Federal Highway Administration (FHWA) classifies our Nation's urban and rural roadways by road function. Each function class is based on the type of service the road provides to the motoring public, and the designation is used for data and planning purposes. The amount of mobility and land access offered by these road types differs greatly. For the purpose of this Plan, FHWA's road function classes are discussed as (1) Interstate, (2) Primary Highway, and (3) Secondary/Frontage Roads. Each road type is defined below in terms of mileage, right-of-way characteristics, and typical management and maintenance activities. *Appendix D* shows a diagram each road type and associated right-of-way.

The Interstate System is the highest classification of roadways in the United States. These arterial roads provide highest level of mobility and speeds over the longest uninterrupted distance. Interstates nationwide usually have posted speeds between 55 and 75 miles per hour. Typical distance from rights-of-way fenceline to fenceline on Interstate roadways is 260 feet, with 80 feet of road surface, and 180 feet of non-roadway (21.8 acres per centerline mile). Maintenance of Interstate rights-of-way typically includes mowing fenceline to fenceline (when appropriate), cutting trees and brush, cleaning ditches, and periodically blading shoulders where material build up prevents drainage off of the road.

Primary Highways include major roads that connect local roads and streets with Interstate. These roads provide less mobility than Interstate at

lower speeds and for shorter distances, and balance mobility with land access. The posted speed limit on collectors is usually between 35 and 70 mi/h. Typical total width of a primary highway right-of-way is 160 feet, with 32 feet of road surface and 128 feet of non-roadway (15.52 acres per centerline mile). Maintenance activities on primary highway right-of-way are similar to those performed on Interstate ROW. However, primary and secondary highways may require more tree and brush cutting, rock removal, and ditch cleaning than interstates to maintain roadside safety and function.

Secondary Highways and Frontage Roads

include minor roads that connect local roads and streets with Interstate and provide access between an Interstate and an airport, public transportation facility, or other inter-modal transportation facility. Total width of secondary highway and frontage road rights-of-way is 120 feet with 28 feet of road surface and 92 feet of non-roadway (11.15 acres per centerline mile). Maintenance of secondary and frontage rights-of-way is similar to that of Primary Highways.

Stockpiles, facilities, and structures associated with public safety, road construction, and maintenance are also owned and/or managed by MDT. Management of weeds on stockpiles is a concern throughout Montana. Stockpiles may be short lived or last for a number of years depending on use. For example, winter abrasives (sanding materials) are typically crushed to provide a three-year supply, however an all-purpose gradation for road shoulders or approaches can last much longer than three (3) years. The content of the stockpile, configuration, and its age will have an affect on how weeds populate the stockpile.

Facilities include rest areas and equipment yards, which are susceptible to weed invasion. Structures include buildings, fences, guardrails, signposts and other permanent fixtures owned and/or managed by MDT.

Weed Species, Location, and Acreage

Weed lists and categories are described in Chapter 2 and shown in *Appendix A* and *B*. Roadside acreage infested by noxious weeds varies throughout Montana and is influenced by infestation levels on adjacent lands and road type. Although no comprehensive weed inventory has

been conducted on MDT lands, roadside infestations are generally more extensive in western Montana than in the eastern half of the state. For example, noxious weeds occur on about 90% of state-owned rights-of-way in Missoula County. In Lewis and Clark County, application records indicate that an average of about 20% of Interstate, 11% of Primary, and 12% of Secondary road rights-of-way are infested by noxious weeds. Phillips County, in northeastern Montana, has relatively low populations of noxious weeds, with about 2% of roadsides infested. Category 1 noxious weeds infest the greatest acreage on roadsides and other MDT lands.

CURRENT PROGRAM

Inventory

There is no statewide inventory specific to road rights-of-way completed in Montana. However, MDT is currently working on a weed inventory and database system that will be implemented beginning in 2003. Inventories on MDT rights-of-way will be conducted according to guidelines developed by MDT. In addition, most counties with full- or part-time weed district staff maintain records on weed infestations along most MDT rights-of-way.

Management

Weed management priorities on state roadsides are currently based on management objectives established by county weed districts and the State Weed Management Plan. Herbicides, manual and mechanical methods, and biocontrol agents are primary methods used to manage noxious weed populations along roadways. Although mowing and cutting are important components of Montana Department of Transportation roadside vegetation maintenance, it often does little to complement county weed management objectives or activities.

In most counties, Montana Department of Transportation contracts herbicide applications for noxious weed management on roadsides. However, mowing operations for safety, road function, and to a limited extent noxious weed control, are conducted by MDT. The Department may also maintain urban interchanges and some maintenance yards and associated facilities.

Guardrails, delineator [reflector] posts, sign posts, and bridge ends are currently managed for total elimination of vegetation to maintain visibility of structures, facilitate drainage and/or lessen snow drifting. Top-soiling and seeding may be

conducted following construction based on contract specification and site conditions. Management of these areas involves application of soil-residual, non-selective herbicides, either yearly or at appropriate intervals by MDT maintenance crews in an attempt to maintain vegetation-free conditions.

Facilities such as maintenance yards, stockpile areas, and rest areas are also managed by MDT. Total vegetation control is practiced in stockpile areas and maintenance yards. Rest areas are intensively managed for public use including maintenance of trees, shrubs, and mowed turf. Borrow locations are typically MDT owned and are referred to as "pit run" or aggregate source areas. Treatment of these areas for noxious weeds is currently on a case-by-case basis.

Equipment available for vegetation maintenance within MDT includes mowers and herbicide application equipment.

Contracted Noxious Weed Control

Weeds along roads, highways and other MDT facilities and lands are usually managed through contracts coordinated by County Weed Districts (CWD). CWD develops specifications for herbicide application along MDT rights-of-way. In general, CWD staff contacts prospective contractors, and the Division MDT maintenance supervisors select the lowest bid contractor(s) through a competitive bid process.

Biological Control

The Montana Department of Transportation and some County Weed Boards work cooperatively with the U.S. Agricultural Research Service (ARS), Animal Plant Health Protection Service, Montana Weed Control Association, Team Leafy Spurge, and Montana State University to establish biological control agents (insects and pathogens). These efforts will be continued and strengthened as new agents that fit roadside situations become available.

Expenditures for Weed Management Activities

Total expenditure for weed control in 2001 was \$948,186. Expenditures for noxious weed management activities in 2002, and projected expenditures for 2003 and 2004 are shown in Table 3-1 for ten (10) MDT maintenance divisions.

Table 3-1. Current and Proposed Distribution of Noxious Weed Control Funds

Division	FY 2004 Projected Funds	FY 2003 Proposed Distribution	FY 2002 Expenditures
11. Missoula	\$103,311	\$120,000	\$103,311
12. Kalispell	\$143,949	\$150,000	\$143,949
21. Butte	\$186,504	\$190,000	\$186,504
22. Bozeman	\$113,680	\$130,000	\$111,180
31. Great Falls	\$149,256	\$150,000	\$149,256
32. Havre	\$80,000	\$90,000	\$36,704
42. Wolf Point	\$27,836	\$34,000	\$27,836
43. Miles City	\$45,445	\$50,000	\$45,445
51. Billings	\$113,968	\$120,000	\$113,968
53. Lewistown	\$69,006	\$74,000	\$69,006
Sub total	\$1,032,955	\$1,108,000	\$987,159
Headquarters			
Awareness	\$15,000	\$15,000	\$30,000
Inventory	\$24,000		
Contract costs		\$15,000	
HQ facilities	\$2,500	\$2,500	
Total	\$1,074,455	\$1,140,500	\$1,017,159

Figure 1. Location of MDT District Offices in Montana

Chapter 4. Management Methods and Practices

Montana Department of Transportation will implement an integrated approach for managing noxious weeds on state owned rights-of-way. This approach is consistent with national, state, and county directives and laws. Various components of an integrated management program are described in this chapter. Time and resources dedicated to each component will be determined based on state and county objectives.

INTEGRATED WEED MANAGEMENT

Integrated Weed Management (IWM) is an ecological approach to managing weeds by combining manual and mechanical tools, biological agents, cultural methods, and herbicides in a way that minimizes economic, health, and environmental risks. Additional components of integrated weed management include public education and prevention. Each component may be used separately or combined with other methods to implement a more effective management strategy depending on weed and site conditions. The following section describes various invasive plant management tools that will be considered part of an IWM approach for MDT highway rights-of-way in Montana.

PUBLIC AWARENESS & EDUCATION

Early detection and treatment of weeds, and an overall effective preventive weed management program is dependent on education. County Weed Districts, federal agencies, Montana State University Cooperative Extension Service (CES), University of Montana, Montana Department of Agriculture (MDA), Montana Statewide Noxious Weed Awareness and Education Campaign, and the Montana Weed Control Association (MWCA), have been actively involved in educating the public about invasive plants.

There is a critical need for training of MDT employees on noxious weed identification and management. In addition, education and awareness efforts should be expanded to include invasive plant management on transportation corridors. Montana State University CES and individual county weed districts have expressed willingness to assist MDT employees with training. MDT will contact county weed districts and CES to assist with employee training and help forge common goals and understanding to ensure future communication.

PREVENTION & EARLY DETECTION

Transportation corridors serve as major sites for introduction and spread of noxious weeds. Thus, prevention, early detection of newly invading species, and implementing rapid control measures are critical to supporting county and state weed management objectives. Preventing the introduction of invasive plant seeds and vegetative parts into non-infested sites is the most practical and cost-effective weed management method. Measures include use of weed seed free seed, mulch, straw, and topsoil on construction projects; cleaning construction, maintenance, and rehabilitation equipment before moving it to non-infested areas; reseeding after disturbance; maintaining healthy, weed resistant roadside plant communities; not allowing newly established weeds to set seed; and eradication of newly established infestations.

Restoration following roadside construction or other major disturbance is critical for preventing weed invasion. Stockpiling the organic layer and topsoil for redistribution following construction will improve establishment of desirable vegetation. Desirable vegetation that resists weed invasion should be established as soon as practicable from the road edge to the ROW boundary. Construction sites should be monitored for a minimum of three (3) years, and newly invading weeds controlled prior to seed set.

Motorized vehicles have been identified as a major distributor of invasive plant seeds. Preventing establishment of weeds on roadsides where they can be moved by vehicles is critical. Weeds should be controlled in maintenance and equipment yards, parking areas, road turnouts, and other areas frequented by vehicles to prevent movement of seed to uninfested sites. Gravel pits and other sources of construction materials should be free of noxious weeds or quarantined to avoid seed transport.

Equipment used in mowing, brush cutting, and other routine maintenance activities on MDT rights-of-way will be cleaned on a regular basis. A mower can be a virtual weed seeder when mowing through an infested area. Each mower should be cleaned by power washing prior to transferring the mower between Sections, when moving between Counties, or when moving from one route segment

to another if a route segment has known weed populations.

Prevention programs include training employees on invasive plant identification, impacts of invasive species, and management methods. Field employees including MDT engineers, biologists, maintenance and other staff involved in road construction and maintenance activities should receive training. Maintenance employees should also know locations of weed infestations to minimize spread during routine maintenance activities. The Transportation Awareness Program (TAP) should include brochures about noxious weeds and include noxious weeds in presentations to the public.

MANAGEMENT

Manual and Mechanical Methods

Manual and mechanical techniques, such as pulling or cutting, may be used to control some noxious weeds on roadsides especially if populations are relatively small. These techniques can be extremely specific, minimizing impacts to desirable plants and animals, but they are generally labor intensive unless combined with other maintenance activities. Treatments must often be repeated annually, or several times per year to prevent invasive plants from producing seed or re-establishing. Repetitive treatments from laborers and machines may severely trample desirable vegetation and disturb soil, providing conditions for re-invasion by the same or other invasive species. When using manual and mechanical methods, it is especially important to thoroughly clean and inspect all equipment and clothing before moving it off-site. This will lessen the probability of spreading weeds to the next worksite. MDT has developed BMP's through Maintenance Division for mowing.

Hand Pulling

Hand pulling may be a good alternative on sites where herbicides or other methods cannot be used. Pulling or uprooting plants can be effective on annuals and tap-rooted plants are particularly susceptible to control by hand-pulling. Pulling is generally not effective against many perennial weeds such, as leafy spurge, since deep underground stems and roots can re-sprout. In most cases, pulling will not be used as a management method on rights-of-way due to safety concerns. However, hand pulling may be used on stockpiles and maintenance yards for removal of individual species.

Many small infestations of newly invading weed species have effectively been managed by hand pulling or a combination of hand pulling and herbicide treatments. Advantages of hand pulling include its small ecological impact, minimal impacts to neighboring plants, and low cost for equipment or supplies. Pulling is extremely labor intensive, however, and is effective only for relatively small, newly established infestations, even when abundant volunteer labor is available. If volunteer labor is not available, pulling costs for dense infestations of tap-rooted weeds such as spotted knapweed are about \$7000 per acre per year (Brown et al. 1999).

Mowing and Cutting

Mowing and cutting are important components of Montana Department of Transportation roadside vegetation maintenance, and can be modified to enhance invasive plant control. Mowing and cutting can reduce seed production and restrict weed growth, especially in annuals cut before they flower and set seed (Hanson 1996). Timing of mowing is critical to achieve maximum impact on invasive plants, and minimize impacts to desirable vegetation. For example, spotted knapweed (*Centaurea maculosa*) seed production can be significantly reduced by a single mowing at late bud to early bloom growth stage (Watson and Renney 1974.). If mowed earlier, beneficial plants are negatively impacted and spotted knapweed is able to re-sprout and may produce more seed than non-mowed plants. Fall mowing of spotted knapweed for three consecutive years may reduce adult knapweed density (Rinella et al.2001).

Montana Department of Transportation has traditionally mowed roadsides based on aesthetics or a timetable rather than to meet specific weed management objectives. Mowing should be performed only when necessary, and as part of a roadside management plan. Mowing roadside vegetation should be based on plant species, growth stage, and general condition of the roadside community, rather than on an arbitrary timetable. Mechanical mowing may be used to maintain sight distances, control noxious and nuisance weeds, reduce snow drifting, and improve aesthetic values.

Mowing after grasses reach dormancy (usually after July 15) will encourage development of healthy, low maintenance, self-sustaining roadsides. If mowing is required during the growing season, reduce plant shock and root dieback by avoiding mowing shorter than 8 inches (8"). Mowing roadside vegetation too short (scalping) during the

growing season can increase soil temperature and erosion, and reduce vigor and tolerance of desirable species making sites more susceptible to noxious weed invasion. Mowing should be timed to support and not conflict with County noxious weed control plans, and forage removal/haying operations. MDT vegetation management plans will identify mowing areas and timing in conjunction with the county 6-year noxious weed control plans and other considerations.

Roadsides are comprised of an active zone, which is typically the area from the paved shoulder out 15 feet, and a passive zone, which is the remainder of the right-of-way width. Mowing widths in the active zone may be limited to no more than 8 to 10 feet off the edge of pavement in significant resource areas defined by DEQ as state water quality impaired segments, unless needed to maintain proper functioning of highway features (e.g. drainage or snow drift control). The passive zone should not be mowed unless it is a component of a predetermined management issue, such as snow drifting areas, sight distance, aesthetic issues in urban areas, or a component of weed control plans.

Two newly designed commercial mowers have been adapted to apply herbicides during mowing operations. The Brown Brush Monitor incorporates a mowing blade followed by a shielded sprayer for herbicide application. Burch Wet-blade mowers consist of a mowing blade that is “wet” with herbicide and applies herbicide only to cut plants. Benefits of this equipment include reduced herbicide rates and application volume, and elimination of herbicide drift. Mowing with this equipment should be conducted after cool season grasses have produced seed, and mowing height should remain at approximately 8 inches to avoid damage to desirable species. *Appendix E* includes detailed information on the Brown Brush Monitor and Burch Wet-blade Mower.

Mulching

Mulching as a weed management tool can be used on relatively small areas, but will also stunt or stop growth of desirable native species. Mulching cannot control most rhizomatous perennial weeds because extensive carbohydrate reserves allow them to grow through or around the mulch. Mulching as a ground cover to reduce erosion and enhance seedling establishment is discussed under Restoration and in *Appendix F*.

Tilling

Tilling, or other forms of turning soil, is often used for weed control in agricultural crops. Its use on roadsides is largely limited to restoration sites where soils are disturbed during construction or maintenance activities. Tilling is effective against annuals and tap-rooted perennials. Small fragments of some species, particularly perennials with rhizomes such as leafy spurge or Dalmatian toadflax, can resprout following tillage. Best control is achieved when soils are dry, so that remaining plant fragments do not have moisture necessary to survive and re-grow. Tillage should be combined with other restoration tools such as mulching, reseeding desirable species, and possibly herbicide treatments until desirable vegetation is established on the site.

Soil Solarization

Soil solarization is the technique of placing a cover (usually black or clear plastic) over the soil surface to trap solar radiation and cause an increase in soil temperatures to levels that kill plants, seeds, plant pathogens, and insects. In addition, when black plastic or other opaque materials are used, sunlight is blocked which can kill existing plants (Katan et al. 1987). Soil solarization however, can cause significant biological, physical, and chemical changes in the soil that can last up to two years, and deter the growth of desirable native species. Solarization leaves an open substrate that can be readily invaded by both desirable and invasive plants once the plastic is removed (Stapleton 1990). Because of impacts to desirable vegetation, and high cost of installation and maintenance, this method does not fit roadside invasive plant management objectives.

Cultural Methods

Cultural weed management methods enhance growth of desired vegetation that should help slow weed invasion. The use of irrigation, fertilization, plant competition, smother crops, and weed life cycle disruption are methods that can be utilized on roadside rehabilitation projects. Maintaining native or desirable vegetation in a healthy condition and minimizing soil disturbance are beneficial for slowing spread of noxious weeds. Since weeds have an ecological advantage on disturbed, compacted, and/or trampled sites, implementing traffic controls may reduce weed invasion and spread.

Irrigation can be used to manage some weeds however its application on most highway rights-of-way is limited. Irrigation can be used to help

establish vigorous stands of desirable plants quickly and encourage root development thus providing increased competition for invasive plants.

Fire is a natural process that can help maintain or improve health and productivity of native plant communities. However, it is not a safe or practical roadside vegetation management tool that will be considered by MDT.

Biological Management

Use of biological agents for managing noxious weeds is part of MDT's integrated weed management program, and will be coordinated through county weed districts. Biocontrol involves the use of living organisms, such as insects, pathogens, or grazing animals, to recreate a balance of plant species with predators. This tool is often viewed as a progressive and environmentally friendly way to control pest organisms. When successful, it can provide essentially permanent, widespread control with a very favorable cost-benefit ratio.

Biocontrol agents are introduced from the country where the host weed originated. These agents are extensively tested to ensure that they have a very narrow host range, and will not pose a serious threat to non-target plants, especially endangered species. The testing process for a biocontrol agent is typically 3 to 4 years in duration and involves 50 to 75 test plant species with final approval by USDA, Animal Plant Health Inspection Service. Although extensive screening and testing reduces the potential for injury to native plants, biocontrol is not risk-free (Story pers. comm.). Once established, biocontrol agents may persist "forever" which is liability if the agent attacks desirable species (Pemberton 1985; Lockwood 1993, 2000; McEvoy and Coombs 2000). *Aphthona* sp. is a well established biocontrol agent that is impacting leafy spurge in Montana with no apparent damage to native species. An example of introduced biocontrol agent that has impacted native plants include the seed weevil, *Rhinocyllus conicus*, which was first introduced to North America to control non-native thistles in the 1960s and now attacks some native thistle (Louda et al. 1997; Louda 2000).

Use of grazing animals will not be a considered weed management tool on state-owned roadsides. High cost of fencing livestock, and liability issues associated with potential livestock incursions with automobiles, restrict use as a roadside vegetation management option.

Fertilization

Use of fertilizer as a weed management tool will cause most noxious weeds to become more vigorous. Fertilizer in combination with reseeding or other restoration techniques may increase vigor of desirable plants and make the site more resistant to weed invasion. Studies conducted in Washington indicate that oxeye daisy may be reduced with applications of 80 lbs of nitrogen fertilizer (Roche, unpublished).

Organic Herbicides

Organic herbicides include vinegar, teas made from straw, knapweed and other allelopathic plants. Researchers at the University of Montana have documented herbicidal actions of a chemical in knapweed. However there has been little documented research on the other organic herbicides. From observations, the effect of these products tends to be non-specific, suppressing plant growth and affecting native grasses and forbs. They may be more effective on annual plants.

Herbicide Management

Herbicides are a valuable tool for managing invasive plants on transportation corridors and a critical component of an integrated management program. As with other management tools, it is important to understand effects and limitations of herbicides proposed for use on roadsides. Herbicides are categorized as selective or non-selective based on their ability to control certain kinds of plants. Selective herbicides will control either broadleaf or grass plants depending on the product selected. For example, 2,4-D and picloram (Tordon 22K) are selective herbicides that will control certain broadleaf plants such as knapweed, and have only minimal to no impact on grasses at recommended application rates. An example of a non-selective herbicide is glyphosate (Roundup) affecting both grasses and broadleaf plants. Herbicides are also selective based on the rate used. Spotted knapweed generally is controlled using a lower herbicide application rate (1 pint of Tordon 22K per acre) than for leafy spurge (2 quarts of Tordon 22K per acre). Application rate will affect potential impact on non-target broadleaf species. At 1 pint per acres Tordon 22K is selective for weeds such as spotted knapweed and sulfur cinquefoil while many native broadleaf plants are not injured.

Herbicides that may be used for noxious weed control on roadsides include picloram (Tordon 22K), dicamba, 2,4-D, MCPA, fluroxypyr (Vista),

clopyralid (Transline/Redeem), triclopyr (Garlon/Redeem), metsulfuron, imazapic (Plateau), chlorsulfuron (Telar), imazapyr (Arsenal), and glyphosate. In addition to the active ingredients which are shown prior to each herbicide name, herbicide formulations also include inert materials, such as carriers and surfactants. **Appendix G** indicates herbicides and rates that will be utilized for control of some noxious weeds. Tebuthiuron (Spike), sulfmeturon (Oust), diuron, and bromacil may be used on a very limited basis for functional and safety aspects along roadsides where more long-term total vegetation control is desired. Herbicide resistance has been known to occur in some weed species such as kochia. Proper selection of herbicides and varying the family of herbicide applied to a site will reduce the opportunity for resistance to occur. For example, if metsulfuron is applied for control of kochia along a roadside, the following year dicamba or 2,4-D should be used on that site.

Properly used, herbicides are effective against most invasive plants. Variation in effectiveness occurs due to weed biology, plant growth stage, application rates, condition of the application equipment, and environmental conditions such as temperature, soil moisture, and precipitation.

Herbicides proposed for use on roadsides have been registered for use by EPA. These herbicides are carefully tested by the manufacturer to determine human health, safety, and environmental effects prior to registration. Herbicide application made to road rights-of-way will be made within label directions by state certified herbicide applicators.

MDT Maintenance Division has licensed applicators that could apply herbicides for noxious weed management on rights-of-way. Although most herbicide applications are currently contracted through county weed districts, MDT may resume responsibility for weed control on some rights-of-way. Weed management activities, including herbicide applications, would be coordinated with respective county weed districts to help assure correct application method, timing, and noxious weed species and location.

RESTORATION & REHABILITATION

Restoration is a critical component of roadside invasive plant management programs. Healthy plant communities are more resistant to weed invasion. Restoration of roadside plant communities will ultimately reduce costs associated

with invasive plant management and reduce maintenance costs from mowing.

Both native and non-native species should be considered in reseeding disturbed sites. Choice of species will be based on objectives for the site, environmental conditions, species biology, ease of establishment, and resistance to weed invasion. Road shoulders are a critical area for developing plant communities that resist weed invasion. Seeding objectives and requirements may vary between the road shoulder and those areas located beyond 15 to 20 feet from the road edge. Seeding considerations are shown in **Appendix H**.

Seeding methods should be consistent with site conditions and seeding rates adequate to fill as many niches as possible. Low growing grasses have been shown to slow weed invasion and are well suited to roadsides. These species should be planted from the edge of the pavement to at least 15 feet. Taller species that are resistant to weed invasion include Russian wild rye and tall fescue. These species can be seeded beyond the road shoulder area where slightly taller vegetation may improve weed resistance by shading.

Mulching generally can improve overall germination and seedling establishment, and protect the soil resource. Certified weed-seed-free straw or native hay can be placed on the site by hand, choppers, or with a blower for large areas. Straw mulch often needs to be anchored to prevent being blown or washed away by overland water flow. The use of tackifiers, plastic, or biodegradable netting is an effective way to retain the straw on the site. Mechanical crimpers have also been used to push the straw into the soil surface on sites where the use of heavy equipment is feasible. Hydro-mulching and use of pre-made erosion control mats may be necessary on steep sites or those with high erosion potential.

Construction projects should be required to remove and save topsoil that would be replaced after construction activities are complete. Construction of slopes of 2:1 or greater should be avoided whenever possible. If steep slopes are unavoidable, mats or similar ground-cover materials will be utilized to establish vegetation. Vegetation will be established from the road edge to the ROW boundary where possible.

INVENTORY, MONITORING & EVALUATION

Inventory, monitoring, and evaluation are critical components of a roadside vegetation management plan because they help determine if the program accomplishes plan objectives. Inventory of existing weed infestations is necessary to identify boundaries of newly invading species, develop long-term management goals and objectives, implement action plans, and evaluate the status of weed management efforts. Monitoring and evaluation are necessary to establish baseline data on site condition and record changes in vegetation trends before and after implementing weed management practices. Evaluation relates information obtained from monitoring to the objectives of the annual plan of operation.

Inventories provide information on weed biology and ecology, help predict high-risk sites for weed invasion, direct management decisions, and raise

public awareness. Historic inventory data indicates that roadsides are high-risk sites for weed invasion, and should be inventoried annually to support prevention, early detection, and rapid response programs. Inventory standards are provided in the Montana Noxious Weed Survey and Mapping System and International Mapping Standards. MDT is currently developing broad-scale inventory methods that will be implemented statewide to determine general levels of weed infestations on roadsides.

Monitoring and evaluation efforts should be implemented to measure status of projects. Monitoring efforts should be both short and long-term depending on project objectives. The level of monitoring will vary based on resources and manpower available. Monitoring includes all aspects of the integrated program including public education and awareness, prevention, restoration projects, and roadside weed management.

Chapter 5. Plan of Action – Integrated Roadside Management Strategies

The magnitude of noxious weed infestations on roadsides in Montana requires a comprehensive plan of action that includes six major components. These components are: 1) public awareness and education; 2) prevention and early detection; 3) rapid response of new introductions to non-infested sites or ecosystems, and implementation of integrated management methods for species that are widely established; 4) restoration and rehabilitation; 5) research and new technology; and 6) inventory weed populations, and monitor and evaluate program results to measure progress towards expected results. The noxious weed management strategy will be compatible with Montana's overall weed management plan.

The Department of Transportation in cooperation with county, state, and federal entities will implement an integrated approach for managing weeds on roadsides in Montana. Management actions are based upon principles and practices consistent with current science, and will incorporate prevention, early detection and rapid response, control, and restoration strategies to meet management objectives. Action items for each component of the Integrated Roadside Weed Management Program will be addressed in this chapter of the plan, and summarized in *Table 6-2*.

PUBLIC AWARENESS & EDUCATION

Public education is a critical component of the Montana State Weed Management Plan. Expected result of the public awareness and education component is to **increase public awareness of noxious weeds on roadsides and improve training for MDT and county employees on identification and management of state and county designated noxious weeds.**

ACTION ITEMS:

1. Develop demonstration areas in cooperation with county weed districts on various weed management methods.
2. Conduct training programs for MDT employees on weed identification and management.
3. Distribute noxious weed information during local and regional events via Transportation and Awareness Program (TAP).

PREVENTION & EARLY DETECTION

Roadsides are highly susceptible to invasion and establishment of newly invading weed species. A comprehensive approach for preventing establishment and spread of noxious weeds on roadsides in Montana is critical to the success of this plan. Expected result of the prevention component of this plan is to **reduce establishment and stop seed production and spread of newly invading weeds on roadsides, stockpiles, and other MDT lands.**

ACTION ITEMS:

1. Inventory roadsides and stockpiles for noxious weeds and permanently identify the location of newly invading species.
2. Institute a rapid response program to stop establishment and spread of newly invading species, and eradicate infestations when possible.
3. Inform Montana Department of Agriculture, MDT, and county weed district on location of newly invading weeds (Category 2 and 3) and permanently identify sites.
4. Monitor treated sites three times annually until seed is no longer viable in soil. Eradicate newly germinating weeds prior to producing seed.
5. Work in cooperation with county, state, and federal entities to develop best management practices (BMP's) for road construction activities.
6. Identify roadside sites susceptible to weed invasion, such as post construction areas, and monitor sites for weed invasion.

RAPID RESPONSE & MANAGEMENT

Management of roadside noxious weeds in Montana may vary based on weed species present, county objectives, road type including Interstate, Primary, and Secondary roads, and roadside "Zone". The expected result is to **implement cost-effective integrated programs to stop seed production and expansion of noxious weed infestations on roadsides.** Management tools will be adapted to meet functional and safety requirements mandated by law, while promoting

healthy, low-maintenance, weed resistant plant communities on roadsides.

Description and function of various road types are discussed in Chapter 3, Existing Situation and Current Program. Roadside management zones are described below.

Roadside Management Zones

Zone 1 - Operational Zone: The “operational zone” (Zone 1) includes the roadside area starting at the edge of the paved area extending to a minimum of fifteen feet (15’). This zone is highly vulnerable to invasion by weed species and will be managed to stop weed seed production.

Zone 2 - Transitional Zone: The “transitional zone” (Zone 2) includes the roadside area, starting fifteen feet (15’) from the edge of the paved area to the right-of-way line. General weed management objectives for “transitional zones” are to control weeds in areas where there are active Cooperative Weed Management Areas or where adjacent lands are relatively free of noxious weeds. Satellite noxious weed infestations will be contained and controlled.

Zone 3 - Stockpiles, Structures and Facilities: Stockpiles include materials in stockpiles in addition to stockpile sites. Structures include areas in and around guardrails, delineator [reflector] posts, sign posts, bridge ends, and stockpile areas. Facilities include maintenance yards and rest areas and other properties owned or managed by MDT. Controlling noxious weed seed production is a priority within this zone.

Roadside Management Priorities

1. Early detection and rapid control of new infestations and newly invading weed species.
2. Complete control or eradication of established priority noxious weeds occurring as satellite infestations on roadsides.
3. Restrict or minimize noxious weed seed production from pavement edge to 15 feet along the highway shoulder (Zone 1) to reduce seed movement by vehicular traffic
4. Control noxious weeds from the edge of pavement to ROW boundary in areas where adjacent lands are weed-free,

support relatively low weed populations, and/or are involved in active weed management programs.

5. Expand biological management efforts on Zone 2 roadsides and/or on adjacent lands in areas where adjacent lands are infested.

New Invaders:

Operational (Zone 1), Transitional (Zone 2), and Stockpiles, Structures & Facilities (Zone 3):

Early detection and rapid control of new invaders is the highest priority on roadsides and other MDT managed lands in Montana. These species are targeted for early detection and eradication regardless of road type or management zone. Species include those within Category 2 and 3 of the Montana Noxious Weed List. Counties may also classify weeds in Category 1 as “new invaders” if species are not currently present or present in only small infestations within their county.

ACTION ITEM:

1. Control established new invaders with hand pulling, digging, and/or herbicide treatments to achieve complete removal of the species.

Established Noxious Weeds:

Category 1 weeds are present in Montana in relatively large infestations. Management of these weeds will vary based on county objectives, status of weed infestations on adjoining lands, presence of Cooperative Weed Management Areas (CWMA), and roadside Zone. Control of seed production and containment of lateral spread on all satellite infestations of noxious weeds will occur within both Zone 1 and 2.

Management in Zone 1, from the edge of the paved area extending to a minimum of 15 feet, will be managed the same regardless of road type. Management of infestations in Zone 2 will vary based on weed species, size of infestation (scattered versus solid infestations), and management objectives on adjacent lands.

Zone 1: Operational Zone

ACTION ITEMS

1. Control noxious weed seed production and spread of satellite weed infestations within Zone 1.

2. Coordinate roadside application schedule between herbicide applicators and MDT mowing operations to obtain most effective control of noxious weed seed production on roadsides.
3. Utilize mowing and herbicides to establish and maintain a 15 foot buffer along highway rights-of-way to reduce weed seed spread by vehicular traffic. Mowing will be prioritized based on roadside safety needs regardless of road type or weed growth stage.
4. Restore desirable vegetation that resists weed invasion on disturbed sites or areas where vegetation is not well established.

Management Methods for Zone 1:

Herbicides, mowing, vigilant monitoring, and restoration methods will be used to reduce weed infestations, prevent seed production, and limit or prevent lateral spread within Zone 1 (edge of pavement to 15'). County weed districts and MDT will coordinate roadside mowing and herbicide application so that both methods compliment weed management efforts. Mowing at proper weed growth stage can reduce weed seed production and extend effectiveness of herbicide treatments. However, mowing prior to herbicide treatment may reduce visibility of noxious weeds to applicators. Herbicide use should decline as desirable vegetation improves and open niches decline in the roadside plant community. Applicators may utilize backpack sprayers within this zone for limited noxious weed control and treatments near structures.

In some areas, conventional mowing alone may be used on roadsides where mowing can occur during optimal timing to impact noxious weeds. If possible, conventional mowing should be conducted after cool season grasses have produced seed and when the majority of noxious weeds are at the late bud growth stage (late June to late July). Mowing height during the growing season should not be less than eight (8) inches to reduce impact to desirable species. Mowing later in the season following herbicide application is recommended only to meet safety and functional requirements of roadsides. In general, frequent conventional mowing is not recommended in Zone 2 since it will impact desirable vegetation, may not be needed to meet functional or safety requirements, and will not reduce density of most weed species.

Mowers that incorporate herbicide applicators as either shielded/direct spray or "wicking" may be considered for sites that require mowing and also have dense infestations of noxious weeds. This equipment may provide more effective control than conventional application or mowing equipment on deep-rooted perennials such as leafy spurge, Dalmatian toadflax, Canada thistle, and tall buttercup. A detailed description of this equipment is shown in **Appendix E**.

Hand pulling will not be utilized as a management tool within this zone because of hazards to workers, and scale and density of weed infestations. Mulching with organic or inorganic materials to control weeds will also not be incorporated because of damage to non-target species, and hazards to workers.

Post-treatment monitoring will determine areas where desirable vegetation is lacking or require restoration techniques to increase resistance to weed invasion. Rehabilitation of these sites will include seeding desirable grasses such as sheep or hard fescue that resist weed invasion, have a low growth form that does not require mowing, establishes well on roadsides, and is well adapted to roadside disturbance.

Zone 2: Transitional Zone

Priorities for management of weeds may differ slightly based on county objectives, road segments, size of individual infestations, terrain, and abundance of the weed on adjacent land, or adjoining land management goals and objectives.

ACTION ITEMS:

1. Control seed production, and contain spread on satellite infestations of noxious weeds within Zone 2 roadsides.
2. Contain and control noxious weeds along entire highway rights-of-way in areas where adjoining lands are non-infested, have scattered weed infestations, or are within active CWMA's.
3. Expand biocontrol efforts on widespread weed infestations in areas where adjoining lands are infested.
4. Time mowing operations to limit and reduce seed production on roadside infestations where adjacent lands are infested.

5. Enhance or restore desirable vegetation that resists weed invasion on disturbed sites or areas where vegetation is not well established.
6. Implement follow-up treatments as needed to meet action items and expected results based on evaluation.

Management methods for Zone 2:

Satellite Weed Infestations. Satellite weed infestations are widely scattered infestations of Category 1 noxious weeds, or noxious weeds that are in Category 2 or 3. Management methods for satellite weed infestations include the use of selective herbicides, restoration of disturbed sites, and herbicides in combination with other manual and mechanical methods. Methods selected should provide for complete containment and control of infestations and lead to possible eradication of isolated infestations.

ROW adjacent to non-infested sites, sites with scattered infestations, or active Cooperative Weed Management Areas (CWMA's). Management of noxious weeds along highway rights-of-way in areas that are non-infested to lightly infested, or where there are active CWMA's is critical. Management objectives include preventing seed production and lateral spread of noxious weeds. Management tools should be consistent with those used in adjacent CWMA's and meet control objectives. Herbicides in combination with biocontrol agents, manual methods, site restoration, and/or mowing may provide effective management. Sites should be monitored and re-treated as needed. CWMA locations will be identified by county weed districts by route and milepost.

In general, conventional mowing is not recommended in this zone since it will impact desirable vegetation, is not needed to meet functional or safety requirements, and will not reduce density of most weed species. Modified mowers that also apply herbicide treatments may be considered.

Post-treatment monitoring on a regular basis will determine areas where desirable vegetation is lacking or other restoration techniques are needed to improve plant community resistance to weed invasions. Restoring a more desirable competitive plant community may be advantageous on large

acreage ROW's, especially those that are not currently infested with noxious weeds.

Widespread weed infestations:

Management tools for widespread weed infestations within a county will include restoration of disturbed sites and expanded release of biocontrol agents.

Zone 3: Stockpiles, Structures & Facilities

Management of stockpiles is critical to prevent weeds from establishing and producing seeds and/or other plant propagules. Once weeds have established on stockpiles and produced seed they can easily be distributed to roadsides during maintenance or construction activities. Maintaining weed-free stockpiles is an important component of the roadside vegetation management program.

Presence of bare ground in and around structures and facilities has allowed invasion of noxious and nuisance weeds. Species such as sweetclover, kochia, and knapweeds are well established on most sites. Seeding desirable low-growing vegetation in and around structures will decrease susceptibility to invasion, decrease maintenance, and reduce damage caused by non-selective soil-residual herbicides. Vegetation barriers, such as mats, will also be considered around structures.

Noxious weeds will be controlled within facility and equipment yards, and rest areas to stop weed spread. Mechanical removal or applications of non-residual herbicides will be encouraged in areas where total vegetation control is necessary.

ACTION ITEMS

1. Control undesirable vegetation with physical barriers, mechanical techniques, seeding desirable competitive vegetation, and selective herbicides depending on function of structure or facility.
2. Evaluate need to maintain a 100% vegetation-free area around structures, and consider using foliar-applied, non-selective herbicides, such as glyphosate, for total vegetation control.
3. Establish demonstration areas that seed low-growing, desirable grasses in and around structures to help reduce weed establishment.
4. Eliminate unused or unusable stockpiles to prevent weed establishment.

5. Control noxious and/or nuisance weeds on stockpiles immediately, before they produce seed.
6. Use mechanical methods, hand pulling or non-selective short-residual herbicides to control weed infestations on stockpiles. If a long-residual, non-selective herbicide is used to control noxious weeds on stockpiles, use the lowest rate possible to prevent injury to desirable plants that could occur when materials are placed on roadsides.
7. Maintain weed free aggregate source sites (pits) used by MDT maintenance.
8. Train applicators on herbicide application techniques for total vegetation control to minimize area treated. Treat only the area needed to meet road safety and function requirements.

RESTORATION & REHABILITATION

Restoration planning is an integral component of a roadside weed management program when loss or displacement of desirable species occurs. Without restoration, areas become reinfested with either the same or new weed species. Restoring disturbed roadsides is critical to slow establishment and spread of weed species. The expected result of this component is **to decrease susceptibility of roadside rights-of-way to noxious weed invasion and establishment.**

ACTION ITEMS:

1. Restore desirable vegetation on disturbed roadsides as soon as possible following disturbance activity.
2. Evaluate restoration and rehabilitation projects annually for up to three years following seeding to determine if seed establishment was successful. Restoration/rehabilitation of disturbed roadsides will not be considered completed until desirable vegetation is well established as determined by MDT guidelines.
3. Work with highway design construction engineers to develop best management practices (BMP's) that facilitate establishment of desirable vegetation following construction. This includes, but is not limited to, removal and stock-piling of topsoil for replacement following construction, avoiding steep cut slopes, and consideration of certification for all borrow sites.
4. Identify roadside sites where restoration or reseeding is needed to improve weed resistance of roadside plant communities and develop projects to restore sites.

RESEARCH & NEW TECHNOLOGY

Roadsides serve as a vector for the spread of noxious weeds and are often difficult sites to establish and maintain desirable vegetation. Montana Department of Transportation recognizes the need for research and new technology for road right-of-way vegetation management that minimizes establishment of noxious weeds, facilitates safety and road function, and reduces maintenance costs. The expected result of this component is to **identify, prioritize and facilitate coordination and implementation of research and new technology that will promote reduction of noxious weeds on road rights-of-way.**

Although research and development of new technology is primarily the responsibility of the state maintenance division, counties may identify and assist with research projects.

ACTION ITEMS:

1. Form a task force that includes representatives from MDT, County Weed District, Montana Weed Control Association, landowners, and research community.
2. Review effectiveness of mowing equipment that combines mowing with herbicide application to reduce maintenance costs, herbicide use, and weed management expenditures.
3. Evaluate current restoration/rehabilitation research, and explore the need to increase funding for research related to enhancement or development of new restoration and reclamation techniques on roadsides.
4. Work cooperatively with other agencies and universities on suitable species for roadside revegetation. Competitive species that are low maintenance, low growing, and will not attract big game should be considered.

5. Explore use of alternative total vegetation management treatments especially around guard rails, delineator posts and other similar structures.

INVENTORY, MONITORING & EVALUATION

Inventory:

Expected results of weed inventory are to **accurately inventory and record locations of noxious weeds on roadsides and other MDT lands**. This information is critical for identifying location and boundaries of newly invading species, developing long-term weed management goals and objectives, and used to monitor status of weed management efforts.

ACTION ITEMS:

1. Develop criteria to conduct a statewide weed inventory on roadsides and input data into a database.
2. Work cooperatively with county weed districts to inventory weeds on roadsides and accurately record data.
3. Develop a user-accessible statewide database and would be compatible with State Inventory and Mapping System.

Monitoring:

The expected results of a monitoring system are to measure effectiveness of various programs over time (management, public education, etc) and compile data to develop effective management decisions. The following components are considered a baseline for monitoring the status of weed management program.

ACTION ITEMS:

1. Monitor effectiveness of weed management methods on roadsides and other MDT owned/managed lands.
2. Compare changes in roadside weed inventory data over time.
3. Provide monitoring data to MDT for use in Accountability for Montana's Maintenance Operations (AMMO) process.

4. Assess public opinion towards weeds and weed management practices on roadsides.

Evaluation:

Evaluation is relating information obtained from monitoring to objectives of the annual plan of operation. Evaluations will help determine if the weed management program accomplishes plan objectives, and if the annual operation plan is still desirable and realistic. Evaluation requires analyzing information gained through monitoring, including benefits versus costs, comparing it with the cost/benefit of other alternatives, comparison with untreated areas, and projected costs of no action. A sample monitoring form is included in **Appendix I**.

Necessary changes should be made to the plan of operation based on the following evaluation questions:

- Was the weed population eradicated or adequately suppressed?
- Was the planned procedure used, if not, why did it vary from the original plan?
- Were weed management costs equal to or less than projected costs?
- What was the effect on the target weed?
- Were there any side-effects to non-target organisms from the treatment?
- Should the treatment be repeated or modified?
- Was funding and manpower available at the appropriate time and were they adequate?
- Was personnel training adequate?

Montana Department of Transportation and County Weed Districts will use information gained from monitoring treated weed infestations to improve future weed management efforts on highway rights-of-way. This evolving, or "adaptive" management allows MDT to learn from past experiences, improve effectiveness, and reduce impacts.

ACTION ITEMS:

1. Review implementation of Plan action items annually or as needed.
2. Evaluate effectiveness of action items in meeting Plan expected results.
3. Review expected results and action items of the Plan to determine if they are realistic and desirable.

Chapter 6. Plan Implementation and Budgets

BUDGETS FOR A COMPREHENSIVE WEED MANAGEMENT PROGRAM

A balanced comprehensive roadside weed management program that segments funding toward public education and awareness, prevention, early detection, management, research and new technology, and rehabilitation is vital to successfully manage weed infestations in Montana. Based on current weed acreage figures, about \$1.1 million annually will be needed from MDT Maintenance Division to support components of noxious weed management excluding restoration. Additional \$800,000 (estimate) in funding is needed for rehabilitation of roadsides and other disturbed lands owned and/or managed by MDT. Federal Highway Administration and MDT Construction Division would provide funding for restoration/rehabilitation projects. In addition to these funding sources, existing programs through

MSU CES (Cooperative Extension Service) for training and public education, MDT District Offices (employee time and travel), and County Weed District (training) would cover a portion of costs. The percent of total budgets allocated to each critical component of a weed management program was based on Montana's State Weed Plan and modified to meet roadside situations in Montana. Funding sources and budget allocations for management program components and administrative costs are summarized in *Table 6-1*.

A budget increase of four percent (\$44,000) per year would be necessary to cover increased costs of management activities, potential weed spread, and addition of new road rights-of-way acres. Because of current and projected state-wide budget constraints, this plan is based on current funding allocation of \$1.1 million per year for the next six years.

Table 6-1. Budget Allocation for Weed Management Activities on MDT state owned or managed roadsides and facilities in Montana

	Suggested Budget Distribution	Statewide MDT Maintenance Division (\$)	MDT Maintenance Divisions – employee expenses (\$)	In kind- CWD & CES (\$)	Federal funds & Construction Division (\$)	Budget Total Including In-kind funds (\$)
1. Public Education/training	5%	55,000	55,000	28,000		138,000
2. Prevention	5%	55,000				55,000
3. Rapid Response	8%	88,000				88,000
4. Management**	63%	688,519	68,000			756,519
5. Restoration (calculated separately)					800,000	800,000
6. Research & New Technology	5%	55,000				55,000
7. Inventory/monitoring*	7%	77,000	28,000			105,000
<i>Sub total (Sum of 1-7)</i>	<i>93%</i>	<i>1,018,519</i>	<i>151,000</i>	<i>28,000</i>	<i>800,000</i>	<i>1,997,519</i>
8. Administration (8% of Subtotal)	7%	81,481	12,080	2,240		95,801
TOTAL	100%	1,100,000	163,080	30,240	800,000	2,093,320
Restoration (federal funds and Construction Div)	73%	800,000				

* includes \$23,930 for inventory (\$2.00/CL mile)

** In-kind costs of \$68,000 under management are for traffic control including signs

(1) Public Education & Training. Five percent (\$55,000) of the total budget is allocated towards public education and training. In-kind services in

the form of travel and salaries are provided by MDT Divisions (\$ 55,000), and County Weed

Districts (CWD) / Cooperative Extension Service (CES) (\$28,000).

(2) Prevention & Early Detection. Five percent (\$ 55,000) of the total budget is allocated to prevention activities described in action items.

(3) Rapid Response. Estimated costs for rapid response program comprise 8% (\$88,000) of the total budget. Discussion about rapid response is described under Prevention and Early Detection and under Management (New Invaders) in Chapter 5.

(4) Management. Approximately 63% (\$688,519) of the total budget is allocated toward management of MDT lands. In-kind funds (\$68,000) provided by MDT Divisions is for providing assistance to county weed districts for traffic control including signs.

(5) Restoration & Rehabilitation: About \$800,000 is needed for restoration and rehabilitation of roadsides including revegetation of existing disturbed sites. Funding for these projects is from Federal Highway Administration and MDT Construction Division.

(6) Research & New technology: Five percent (\$55,000) of the total budget is allocated towards research and new technology. Funding is generally for statewide research projects, and dollars are not provided to counties unless specifically involved in research or demonstration project.

(7) Inventory & Monitoring. Seven percent (\$77,000) of the total budget is allocated towards inventory and monitoring. Inventory costs include \$2.00 per centerline mile of MDT roadsides

provided for roadside inventory and support of a statewide inventory database. Monitoring includes database management and other activities described in Action Items.

(8) Administration: Administrative costs comprise 7% of the total budget, and are based on 8% of the six management plan components.

IMPLEMENTATION

The key to success of MDT's Integrated Weed Management Plan is dependent on the ability of responsible entities to implement action items identified in the Plan. Table 6-2 identifies key action items within the plan, responsible entity, and estimated date for completion.

EVALUATION & REVISION

Evaluation of progress on action items is critical to determine whether modifications or additions to the plan are necessary to improve facilitation and implementation. The work plan will be reviewed annually by April 1 to determine if action items are implemented, and if objectives are being met.

MDT's Integrated Weed Management Plan will be reviewed biennially by Montana Department of Transportation, Montana Department of Agriculture and other participants of the Steering Committee. Status of action items will be reviewed, updated as needed, and suggestions identified for facilitation of the Plan. MDT will be responsible for scheduling an annual review process and implementing revisions in the Plan.

The Montana County Weed Control Act (7-22-2151) requires state agencies to complete six-year management plans. Revision of this document will be conducted every six years (2007).

Table 6-2. Action Plan for Integrated Weed Management on MDT Owned and/or Managed Lands

Chapter 7. References

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Chapter 8. Appendices

APPENDIX A. STATE NOXIOUS WEED LIST (2/11/00)

* Note: Noxious weed acres were determined with 48 counties submitting weed acres in 2000 and previous inventory records used for 6 counties, no records were available for 2 counties.

Category 1.	Acres Infested*
Canada Thistle (<i>Cirsium arvense</i>)	1,526,803
Field Bindweed (<i>Convolvulus arvensis</i>)	534,853
Whitetop or Hoary Cress (<i>Cardaria draba</i>)	83,539
Leafy Spurge (<i>Euphorbia esula</i>)	1,027,419
Russian Knapweed (<i>Centaurea repens</i>)	64,466
Spotted Knapweed (<i>Centaurea maculosa</i>)	3,818,450
Diffuse Knapweed (<i>Centaurea diffusa</i>)	27,523
Dalmatian Toadflax (<i>Linaria dalmatica</i>)	204,408
St. Johnswort (<i>Hypericum perforatum</i>)	68,065
Sulfur (Erect) Cinquefoil (<i>Potentilla recta</i>)	275,542
Common tansy (<i>Tanacetum vulgare</i>)	17,089
Ox-eye Daisy (<i>Chrysanthemum leucanthemum</i> L.)	27,153
Houndstongue (<i>Cynoglossum officinale</i> L.)	267,665
Total acres	7,941,376

Category 2.	
Dyers Woad (<i>Isatis tinctoria</i>)	228
Purple Loosestrife or Lythrum (<i>Lythrum salicaria</i> , <i>L. virgatum</i> , and any hybrid crosses thereof).	287
Tansy Ragwort (<i>Senecio jacobea</i> L.)	23,000
Meadow Hawkweed Complex (<i>Hieracium pratense</i> , <i>H. floribundum</i> , <i>H. piloselloides</i>)	6,508
Orange Hawkweed (<i>Hieracium aurantiacum</i> L.)	51,117
Tall Buttercup (<i>Ranunculus acris</i> L.)*	2,005
Tamarisk [Saltcedar] (<i>Tamarix</i> spp.)*	2,885
Total acres	85,940

Category 3.	
Yellow Starthistle (<i>Centaurea solstitialis</i>)	1
Common Crupina (<i>Crupina vulgaris</i>)	0
Rush Skeletonweed (<i>Chondrilla juncea</i>)	38

Watch List.	
Scentless Chamomile (<i>Matricaria maritime</i> L. var. <i>agrestis</i> [Knaf.])	192
White Bryony (<i>Bryonia alba</i> L.)	0

As of this writing (March, 2003) the State Noxious Weed Advisory Committee is recommending addition of the following species to the state noxious weed list:

Yellow flag Iris (*Iris pseudacorus*): add as Category III
Eurasian watermilfoil (*Myriophyllum spicatum*): add as Category III
Yellow Toadflax (*Linaria vulgaris*) add as Category I
Perennial pepperweed (*Lepidium latifolium*) add as Category II
Flowering rush, blueweed and hydrilla add to the "Watch List".

For the most current list of weed species on the state noxious weed list please consult the following website.
<http://agr.state.mt.us/programs/asd/noxweeds.shtml>

APPENDIX B. COUNTY DESIGNATED NOXIOUS WEEDS

APPENDIX C: ROAD MILES AND WEED INFESTATION LEVELS BY COUNTY

APPENDIX D: ROAD RIGHTS-OF-WAY DIAGRAM

APPENDIX E: NEW MOWER TECHNOLOGY

APPENDIX F. MULCHING AND EROSION CONTROL¹

APPENDIX G. MANAGEMENT METHODS

APPENDIX H. CONSIDERATIONS FOR SEEDING

APPENDIX I. WEED TREATMENT EFFECTIVENESS MONITORING FORM